(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 144 234 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**22.03.2017 Bulletin 2017/12**

(21) Application number: **15306464.7**

(22) Date of filing: **21.09.2015**

(51) Int Cl.:
***B65C 3/16*** *(2006.01)* ***B65C 9/04*** *(2006.01)*
***B67C 3/00*** *(2006.01)* ***B67C 3/26*** *(2006.01)*
***B67C 7/00*** *(2006.01)*

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**MA**

(71) Applicant: **SIDEL PARTICIPATIONS**
**76930 Octeville-sur-Mer (FR)**

(72) Inventors:
- **BAST, Tim**
  **CH-6318 Zug (CH)**
- **ZONI, Roberto**
  **43126 Parma (IT)**

(74) Representative: **Siloret, Patrick et al**
**Sidel Participations**
**Avenue de la Patrouille de France**
**76930 Octeville-sur-mer (FR)**

## (54) AN APPARATUS FOR PRODUCING PLASTIC BOTTLES

(57) An apparatus (1) for producing plastic bottles (2) comprising: a blow moulding carousel (20) rotating about a first axis (C) and configured to transform a succession of plastic preforms (3) into respective bottles (2); a filling carousel (24) rotating about a second axis (D), parallel to the first axis (C), and including a plurality of handling units (28) advancing about the second axis (D), receiving the respective bottles (2) fed by the blow moulding carousel (20) and provided with respective filling devices (30) selectively operated to fill the bottles (2) with a pourable product; labelling means (12) configured to feed a succession of labels (4) to be attached to the respective bottles (2); and conveying means (14) configured to transfer the bottles (2) within the apparatus (1); the labelling means comprise a labelling unit (12) arranged peripherally to the filling carousel (24) and configured to feed the labels (4) to the handling units (28) carrying the respective bottles (2) while the handling units (28) are advanced by the filling carousel (24); the conveying means (14) comprise a plurality of consecutive transport star wheels (82) transferring the bottles (2) in a continuous stream from the blow moulding carousel (20) to the filling carousel (24).

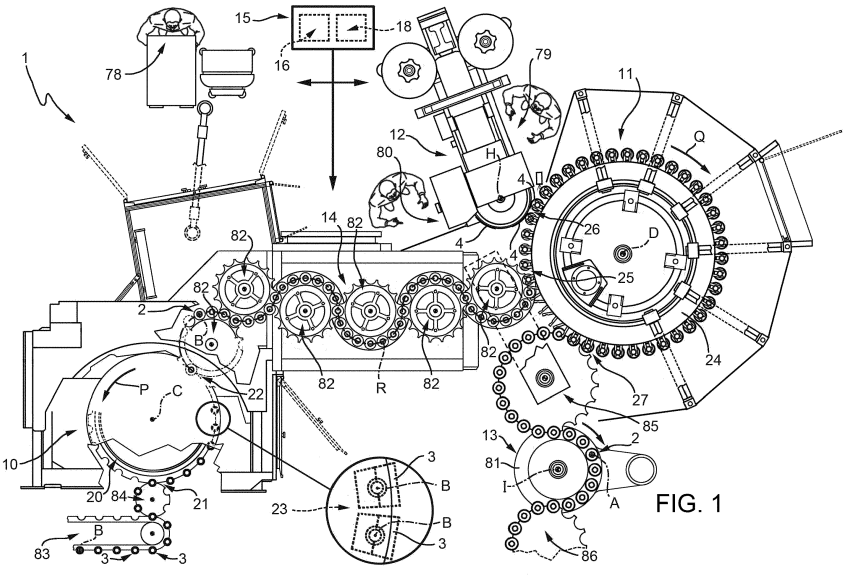



FIG. 1

EP 3 144 234 A1

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to an apparatus for producing plastic bottles; in particular, the present invention relates to an apparatus, in which the plastic bottles are formed from blanks or preforms, filled with pourable products, labelled and preferably capped.

**[0002]** The products poured in the bottles include still (such as still water) or carbonated liquids (such as sparkling water, soft drinks and beer), beverages (including juices, teas, sport drinks, wine, etc.), liquid cleaners, emulsions, suspensions, high viscosity liquids, etc.

**[0003]** It is pointed out that the term "plastic bottle" is used in the present description and in the claims to indicate any type of plastic container which is obtained by a blow moulding process starting from a blank or preform.

### BACKGROUND ART

**[0004]** As known, a wide range of plastic bottles are formed in carousel-type blow moulding machines from plastic preforms. In particular, the heated preforms are accommodated in correspondingly designed blow moulds of the blow moulding machine and are then blown, during rotation of the blow moulding machine, under high pressure and high temperature to form respective bottles.

**[0005]** The bottles exiting from the blow moulding machine are then transferred to a carousel-type filling machine, where such bottles are filled with a pourable product of the above-mentioned type. At this point, the bottles are capped in a further carousel and subsequently transferred to a labelling machine. It is often necessary to provide a long transfer from the capping machine to the labelling machine to allow the bottles to be externally dried prior to proceed with the application of the labels.

**[0006]** In general, in the known apparatuses, there are long transfer paths between the above-indicated different machines, partly also with interposition of buffers; as a consequence, facilities suitable to house this kind of apparatuses need to be relatively extensive, i.e. they require a lot of space.

**[0007]** A need is particularly felt in this field to reduce the footprint of the apparatuses for producing, filling, capping and labelling plastic bottles.

**[0008]** A solution to this problem has been proposed in US 2011/0056172, wherein the labelling machine has been interposed between the blow moulding machine and the filling machine, so that no drying operation is required prior to start the labelling operation, as the bottles exit perfectly clean and dry from the blow moulding machine. However, it is necessary to provide a change of pitch from the blow moulding machine to the labelling machine.

**[0009]** In addition, in the proposed solution of US 2011/0056172, the bottles are transferred without buffers among the blow moulding machine, the labelling machine and the filling machine.

**[0010]** This recently-proposed solution still leaves room for further improvements, especially as to achieve a further reduction of the apparatus footprint and a simplification of the adjustments necessary to synchronize the different processing machines.

### DISCLOSURE OF INVENTION

**[0011]** It is an object of the present invention to provide an apparatus for producing plastic bottles, designed to meet the above needs, and which is cheap and easy to implement.

**[0012]** According to the present invention, there is provided an apparatus for producing plastic bottles as claimed in claim 1.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]** A preferred embodiment is hereinafter disclosed for a better understanding of the present invention, by mere way of non-limitative example and with reference to the accompanying drawings, in which:

Figure 1 shows a schematic top plan view, with parts removed for clarity, of an apparatus according to the present invention for producing plastic bottles;
Figure 2 shows a larger-scale, partly sectioned side view, with parts removed for clarity, of a handling unit of a machine of the Figure 1 apparatus;
Figure 3 shows part of the handling unit of Figure 2 during a different operative step;
Figure 4 shows a larger-scale, sectioned side view, with parts removed for clarity, of a detail of the handling unit of Figures 2 and 3; and
Figure 5 shows a front sectioned view of an example of preform from which the apparatus of Figure 1 produces the bottle illustrated in Figures 2 to 4.

### BEST MODE FOR CARRYING OUT THE INVENTION

**[0014]** Number 1 in Figure 1 indicates as a whole an apparatus according to the present invention for producing plastic bottles 2 (shown in greater details in Figures 2 to 4).

**[0015]** In particular, in the apparatus 1, the bottles 2 are formed from respective preforms 3 (Figure 5), are filled with a pourable product, are capped with respective known closing caps (not shown) and are labelled with respective labels 4 (Figure 3).

**[0016]** The bottles 2 used in apparatus 1 may be filled with any type of pourable product, like carbonated liquids (such as sparkling water, soft drinks and beer), non-carbonated liquids (such as still water, juices, teas, sport drinks, wine), liquid cleaners, emulsions, suspensions, high viscosity liquids, powder products, etc.

**[0017]** As visible in Figures 1 to 4, each bottle 2 has a

longitudinal axis A, which runs in a vertical direction within apparatus 1. Each bottle 2 is bounded at the bottom by a bottom wall 5, substantially perpendicular to axis A, and has a top neck 6 substantially coaxial with the axis A itself and defining an inlet/outlet mouth; the neck 6 is preferably equipped with a threaded surface 7 designed to allow the closing off by capping of the final bottle 2.

**[0018]** In the preferred embodiment shown in Figure 5, each preform 3 is made from thermoplastic material and comprises a top neck 8, which is at its definitive shape identical to that of the neck 6 of the corresponding bottle 2, and a wall 9 bounding an internal closed volume only accessible through the mouth of the neck 8. In particular, each preform 3 has a main longitudinal axis B, which runs in a vertical direction within apparatus 1. The wall 9 of each preform 3 has a U-shaped cross section in a plane containing the relative axis B. A part of the wall 9, opposite neck 8, defines, in the vertical direction, the bottom of the preform 3 destined to be transformed, during production of the relative bottle 2, into bottom wall 5 thereof.

**[0019]** With reference to Figure 1, apparatus 1 comprises:

- a blow moulding machine 10 configured to transform a succession of preforms 3 into respective bottles 2;
- a filling machine 11 configured to introduce a predetermined volume of a pourable product into each bottle 2;
- a labelling unit 12 configured to feed a succession of labels 4 to be attached to the respective bottles 2;
- a capping machine 13 located downstream of filling machine 11 and configured to provide bottles 2 with relative closing caps after filling; and
- a conveying system 14 configured to transfer the bottles 2 within the apparatus 1.

**[0020]** Apparatus 1 also comprises a central electronic control system 15, which in turn includes:

- an electronic process control unit 16 for monitoring and controlling the operations of blow moulding machine 10, filling machine 11, labelling unit 12 and capping machine 13 as well as the various components of conveying system 14; and
- a power supply unit 18 for supplying electrical power to any member of the apparatus 1.

**[0021]** Blow moulding machine 10, filling machine 11 and capping machine 13 are all of carousel-type.

**[0022]** In particular, blow moulding machine 10 comprises a blow moulding carousel 20, which is mounted to rotate continuously (anticlockwise in Figure 1) about a vertical axis C perpendicular to the Figure 1 plane. The carousel 20 receives a succession of preforms 3 at an input station 21 and releases a succession of bottles 2 at an output station 22, angularly spaced from the input station 21 about axis C.

**[0023]** Blow moulding machine 10 further comprises a plurality of moulding units 23 (known per se and only schematically shown in Figure 1), which are equally spaced angularly about axis C, are mounted along a peripheral portion of carousel 20 and are moved by the carousel 20 itself along a transfer path P extending about axis C and through input and output stations 21 and 22.

**[0024]** Each moulding unit 23 is configured to receive the respective preform 3 with its axis B parallel to the axis C as well as to transform the preform 3 itself into a respective bottle 2. More specifically, each moulding unit 23 includes, in a known manner, injecting means (not shown) for introducing a fluid under pressure in the respective preform 3 through its neck 8 so as to deform the wall 9 up to the final shape of the bottle 2. The preforms 3 are previously heat treated in an oven (known per se and not shown) in order to soften the material composing them prior to be subjected to the actual blow moulding operations on the carousel 20.

**[0025]** With reference to Figures 1 to 4, filling machine 11 comprises a filling carousel 24, which serves not only to fill the bottles 2 with the pourable product but also to label them with the respective labels 4 fed by labelling unit 12.

**[0026]** Carousel 24 is mounted to rotate continuously (clockwise in Figure 1) about a vertical axis D, parallel to axis C. The carousel 24 receives a succession of empty bottles 2 at a first input station 25 and a succession of labels 4 at a second input station 26, arranged downstream and angularly spaced from the input station 25 about the axis D; the carousel 24 releases a succession of filled and labelled bottles 2 at an output station 27, angularly spaced from the input stations 25, 26 about axis D and arranged downstream thereof.

**[0027]** Filling machine 11 also comprises a plurality of handling units 28, which are equally spaced angularly about axis D, are mounted along a peripheral portion of carousel 24 and are moved by the carousel 24 itself along a transfer path Q extending about axis D and through stations 25, 26 and 27.

**[0028]** As shown in detail in Figures 2 to 4, each handling unit 28 comprises a support device 29 configured to receive and retain a relative bottle 2 in a vertical position, in which such bottle 2 has its axis A parallel to the axis D of carousel 24, and a filling device 30 selectively operated to feed the pourable product into the bottle 2 itself as the support device 29 travels along transfer path Q.

**[0029]** Each filling device 30 is conveniently arranged above the bottle 2 to be filled and each support device 29 projects downwards from the relative filling device 29 and supports the bottle 2 itself in a suspended position.

**[0030]** As the handling units 28 are completely identical to each other, only one will be described in detail hereafter, for the sake of clarity and simplicity.

**[0031]** With particular reference to Figures 2 to 4, filling device 30 comprises a vertical hollow post 31 with a cylindrical shape, which has a longitudinal axis E, parallel

to axis D, and is fixed to the peripheral portion of the carousel 24.

**[0032]** Post 31 is radially delimited by an inner surface 32 comprising an upper wide portion 33 and a lower narrow portion 34, and is engaged in a sliding manner by a shutter 35 with a tubular shape, which is mounted inside the post 31 coaxial to the axis E.

**[0033]** Shutter 35 projects downwards from a lower opening of post 31, and is coupled to the latter by means of a deformable annular membrane 36, which is in turn interposed between the post 31 and the shutter 35 themselves.

**[0034]** Shutter 35 defines, together with post 31, an annular feeding conduit 37, which extends between post 31 and shutter 35 and is connected, through a product circuit 38 (known per se and only schematically shown) and an ON/OFF valve 39, to a tank 40 (also known per se and schematically shown) containing the pourable product to be fed into the bottles 2.

**[0035]** Shutter 35 is provided, on its outer surface, with an annular elastomeric gasket 41 configured to cooperate in use with lower narrow portion 34 of inner surface 32 of post 31; shutter 35 also has a lower tubular end portion 35a extending downwards coaxially with axis E from the portion provided with gasket 41.

**[0036]** Shutter 35 is axially movable between a lowered closing position (Figures 2 to 4), in which gasket 41 of the shutter 35 is arranged in contact with lower narrow portion 34 of inner surface 32 of post 31 so as to be coupled to the latter in a fluid-tight manner and close conduit 37, and a raised opening position (not shown), in which the conduit 37 itself is open.

**[0037]** Shutter 35 is moved to its raised opening position - and normally kept there - by a spring 42, which is mounted between the post 31 and the shutter 35 coaxial to axis E, and is moved to its lowered closing position, against the action of the spring 42, by an actuating cylinder 43.

**[0038]** More specifically, actuating cylinder 43 is arranged within post 31 coaxial to axis E, is provided with a piston 44, which is coupled to shutter 35 in an axially and angularly fixed manner, and is connected to a known pneumatic device, which is not shown.

**[0039]** By setting valve 39 in an open condition and shutter 35 in the raised opening position, the pourable product can flow within the relative bottle 2 so as to define a filling operation thereof.

**[0040]** Shutter 35 also has a swirler 45, which is obtained on the outer surface of the shutter 35 itself, and extends along - and around - axis E, so as to cause the pourable product fed along conduit 37 to have a swirling movement.

**[0041]** Shutter 35 defines an inner feeding conduit 46, which is connected, through a pressurization circuit 47 (known per se and only schematically shown) and an ON/OFF valve 48, to a chamber 49 (also known per se and schematically shown) formed in the carousel 24 and filled with a pressurization fluid, e.g. carbon dioxide.

**[0042]** By setting valve 48 in an open condition, it is possible to pressurize the relative bottle 2 carried by the handling unit 28 to a given pressure value higher than the atmospheric pressure. This pressurizing step serves to two purposes:

- to make each bottle 2 sufficiently rigid for a labelling operation, which is carried out on the same carousel 24 and will be described in detail later on; and
- in case of a filling operation to be performed with a carbonated product with or without a labelling operation, to take each bottle 2 to the requested condition for filling.

**[0043]** It is pointed out that the pressure values required for filling a bottle 2 with a carbonated product may be different and in particular higher than the pressure values required only to make the bottle 2 sufficiently rigid for a labelling operation.

**[0044]** Filling device 30 also comprises a tubular element 50, which extends around a lower end 51 of post 31, is mounted coaxial to axis E, and is coupled to the post 31 itself in an angularly and axially fixed manner.

**[0045]** Support device 29 comprises a substantially cylindrical support bell 52 of axis E, which is externally coupled to tubular element 50 in an axially fixed position and in a rotary manner about the axis E itself, and a gripping member 53 projecting downwards from the bell 52 and configured to retain a relative bottle 2 by the neck 6.

**[0046]** In particular, bell 52 extends coaxially around tubular element 50. More specifically, bell 52 is coupled to tubular element 50 by interposing one or more rolling bearings 54, two in the example shown, so as to rotate around axis E relative to the tubular element 50 itself and under the thrust of an actuating device 55, in turn extending on one side of filling device 30.

**[0047]** As clearly visible in Figure 2, actuating device 55 comprises an electric motor 56, which is fixed to the carousel 24 on one side of post 31, and is provided with an output shaft 57 having a longitudinal axis F that is parallel to axis E.

**[0048]** Shaft 57 is coupled to bell 52 by means of a pair of gears 58, 59, one of which (58) is angularly secured to the shaft 57 and the other (59) is formed on the outer surface of the bell 52 itself.

**[0049]** Gripping member 53 comprises a support arm 60, which projects downwards from bell 52, is fixed to the bell 52 itself and supports a pair of holding jaws 61, which are configured to hold a relative bottle 2 in correspondence to its neck 6.

**[0050]** In particular, support arm 60 projects from a bottom surface of bell 52 in an eccentric position with respect to axis E.

**[0051]** Jaws 61 are mounted under arm 60 and are hinged to the arm 60 itself so as to rotate, relative to the latter, around a fulcrum axis G, which is parallel to axis E.

**[0052]** Jaws 61 are normally set in a clamping position under the thrust of a spring 62, which is interposed be-

tween the jaws 61 themselves; in use, jaws 61 are moved to a release position by the thrust exerted thereon by the relative bottle 2 during its insertion into gripping member 53 or its extraction from the gripping member 53.

**[0053]** Filling device 30 also comprises a filling head 63, axially projecting downwards, i.e. towards the relative jaws 61, from post 31 and with respect to the relative bell 52, and further comprising an annular elastomeric gasket 64, which has an annular shape coaxial to axis E, is designed to cooperate, in use, with top neck 6 of the relative bottle 2 and is carried by post 31.

**[0054]** In particular, the gasket 64 is secured to an annular element 65, in turn cooperating with lower end 51 of the relative post 31 through a further elastomeric gasket 66 and a rolling bearing 67.

**[0055]** In particular, lower end 51 of the relative post 31 defines at the bottom, i.e. towards the relative jaws 61, an annular cavity 68, open towards the jaws 61 themselves and delimited by an inner annular wall 69 and an outer annular wall 70; in greater details, inner annular wall 69 delimits, on its outer side, the annular cavity 68, and, on its inner side, the conduit 37; outer annular wall 70 outwardly faces bell 52.

**[0056]** Annular element 65 is housed within annular cavity 68 and cooperates with inner annular wall 69 of post 31 through gasket 66 and with outer annular wall 70 through rolling bearing 67.

**[0057]** The gasket 64 of each handling unit 28 is sandwiched between annular element 65 and an annular disk-shaped cover 71, secured to the annular element 65 itself.

**[0058]** As a result of the arrangement above described, annular element 65, gaskets 64, 66 and cover 71 can rotate in use with respect to post 31 around axis E under the thrust of the relative bottle 2. During this rotation, gasket 66 slides on inner annular wall 69 of the relative post 31 ensuring sealing thereof.

**[0059]** As clearly shown in Figures 2 to 4, in each handling unit 28, gasket 66 is axially interposed between the gasket 64, destined to cooperate with the relative bottle 2, and the gasket 41 of the shutter 35 cooperating with lower narrow portion 34 of inner surface 32 of the post 31 in the lowered closing position of the shutter 35 itself.

**[0060]** Support device 29 of each handling unit 28 may additionally comprise a lower support plate 72 (Figure 3), on which bottom wall 5 of the relative bottle 2 rests.

**[0061]** According to another possible embodiment not shown, gripping members 53 may be removed and lower support plates 72 may be motor-operated so as to rotate the respective bottles 2 around the relative axes E; in this case, the rotary motion imparted to each bottle 2 by the respective lower support plate 72 would be transmitted to the relative filling head 63 by means of the bottle 2 itself.

**[0062]** As shown in Figures 2 to 4, post 31 further defines an annular decompression conduit 73 connecting an annular volume V, formed between lower end 51 of the post 31 and lower end portion 35a of shutter 35, with a decompression circuit 74 (known per se and only schematically shown), in turn connected to a discharge device 75 (also known per se and only schematically shown) through an ON/OFF valve 76.

**[0063]** As a result of the described structure, each handling unit 28 is configured not only to support and fill a relative bottle 2 but also to rotate such bottle 2 about its axis A during its movement along transfer path Q together with carousel 24. This kind or rotary motion is imparted to each bottle 2 by electric motor 56 and gripping member 53 of the relative handling unit 28.

**[0064]** In practice, each bottle 2 has, in use, a revolution motion about axis D together with carousel 24 and a rotary motion about its own axis A as a result of the torque imparted by the relative electric motor 56 and gears 58, 59 to the relative gripping member 53.

**[0065]** In this way, the post 31 and the tubular element 50 define a fixed portion X of the relative handling unit 28, whilst the bell 52 and the gripping member 53 define an active rotary portion Y of the handling unit 28 itself, capable of imparting a rotary motion to the relative bottle 2; in addition, the gaskets 64, 66, the annular element 65 and the cover 71 define a passive rotary portion Z of the relative handling unit 28 as such components are dragged into rotation in use by the relative bottle 2.

**[0066]** With reference to Figures 1 and 3, labelling unit 12 is arranged peripherally to carousel 24 and is configured to feed the labels 4 to the respective handling units 28 carrying the respective bottles 2, while such units 28 are advanced along transfer path Q by the carousel 24 and pass by the labelling unit 12 itself.

**[0067]** As visible in Figure 1, labelling unit 12 cooperates with carousel 24 at input station 26, which is preferably arranged closer to input station 25 than output station 27.

**[0068]** In the embodiment shown in Figure 1, labelling unit 12 is arranged adjacent to a first sector of the carousel 24, immediately downstream of the position at which the bottles 2 are fed to the carousel 24 itself by the conveying system 14, i.e. immediately downstream of input station 25.

**[0069]** With particular reference to the embodiment shown in Figures 1 and 3, labelling unit 12 preferably comprises a label transfer drum 77 carrying the labels 4 on its outer lateral surface by suction and rotating about an axis H, parallel to axes C, D, E, F. More specifically, the drum 77 is arranged tangentially to carousel 24 so as to transfer each label 4 to the adjacent bottle 2 passing by the drum 77 itself.

**[0070]** In order to allow application of each label 4 on the corresponding bottle 2, the latter is rotated about its axis A by switching electric motor 56 to an active state.

**[0071]** As it will be explained in greater detail hereafter, the application of each label 4 on the corresponding bottle 2 is performed after pressurization of such bottle 2 by opening valve 48 of the relative pressurization circuit 47.

**[0072]** With reference to Figure 1, blow moulding machine 10, filling machine 11 and labelling unit 12 have respective control panels 78, 79, 80, which are config-

ured to control the operations performed by said machines and labelling unit, are connected to electronic process control unit 16 and are electrically powered by power supply unit 18.

**[0073]** With particular reference to Figure 2, control panel 79 of filling machine 11 is connected to electric motor 56, piston 44 and ON/OFF valves 39, 48 and 76 of each handling unit 28.

**[0074]** Control panel 79 is configured to set each electric motor 56 in the active state in order to rotate the relative gripping member 53 supporting a relative bottle 2 during labelling and filling thereof with the pourable product.

**[0075]** Angular speed imparted to each bottle 2 during application of one relative label 4 is preferably higher than that imparted to the same bottle 2 during filling with the pourable product.

**[0076]** In order to obtain rotation of each bottle 2 during filling thereof with the pourable product, control panel 79 simultaneously maintains the shutter 35 of the relative handling unit 28 in the upper opening position, the relative valve 39 in the open condition and the relative electric motor 56 in the active state, so as to rotate the relative gripping member 53 about the respective axis E.

**[0077]** By rotating each bottle 2 about its axis A while the same bottle 2 is filled with the pourable product by the relative filling device 30 and is transported in a revolution motion along transfer path Q by carousel 24, it is possible to obtain the following effects:

- the centrifugal force caused by this double rotation generates an additional pressure on the pourable product in the bottle 2, which entraps the carbon dioxide into the product; and
- the pourable product comes down into the bottle 2 along the lateral wall thereof instead of centrally.

**[0078]** Both these effects permits to obtain a significant reduction in the formation of foam at the end of the filling operation.

**[0079]** Control panel 79 is advantageously configured to switch each electric motor 56 to the active state so as to rotate the relative gripping member 53, in turn supporting a relative bottle 2, during the decompression step, i.e. while such bottle 2 is put in connection, by opening the relative valve 76, with the discharge device 75.

**[0080]** The applicant has observed that this further rotation imparted to each bottle 2 during the decompression step permits to obtain a further significant reduction in the formation of foam when the bottle 2 itself is released at atmospheric pressure.

**[0081]** The rotation speeds of each gripping member 35 and the respective bottle 2 during the decompression step are progressively reduced to stop at the end of such step.

**[0082]** All the variations in the angular speeds of each gripping member 35 and the respective bottle 2 during filling and decompression are controlled by control panel 79 through suitable commands imparted to the relative electric motor 56.

**[0083]** With reference to Figure 1, capping machine 13 is of known type and basically comprises a capping carousel 81, which serves to cap the filled bottles 2 with respective closing caps and which is mounted to rotate continuously (clockwise in Figure 1) about a vertical axis I, parallel to axis C, D, E, F and H.

**[0084]** Capping machine 13 further comprises, in a known manner, a panel control (not shown), which is configured to control the operations performed by such machine, is connected to electronic process control unit 16 and is electrically powered by power supply unit 18.

**[0085]** With reference to Figure 1, conveying system 14 advantageously comprise a plurality of consecutive transport star wheels 82 having respective axes parallel to axes C, D, E, F, H, I and configured to transfer the bottles 2 in a continuous stream from the carousel 20 to the carousel 24.

**[0086]** The star wheels 82 define a given flow line R, along which the bottles 2 are advanced from carousel 20 to the carousel 24. The flow line R is formed by a plurality of arc-shaped segments, each of which having a concavity opposite to the adjacent one/ones.

**[0087]** As clearly visible in Figure 1, the distance between the carousels 20 and 24 is only defined by the number of star wheels 82 interposed therebetween, without further processing carousels.

**[0088]** The star wheels 82 are advantageously in an even number, preferably equal to six in the example shown. In this way, the carousels 20 and 24 have opposite directions of rotation. This feature together with the fact that the labelling unit 12 is arranged adjacent to a first sector of the carousel 24 immediately downstream of input station 25 make possible to have the control panels 78, 79, 80 located on the same side with respect to flow line R, so as to facilitate installation of the apparatus 1, without any need of operators to pass from one side to the opposite one of the apparatus itself.

**[0089]** Conveying system 14 further comprises a linear conveyor 83 and an input star wheel 84 for feeding the preforms 3 to carousel 20; in particular, star wheel 84 cooperates with carousel 20 at input station 21.

**[0090]** Conveying system 14 finally comprises one star wheel 85 for transferring the filled and labelled bottles 2 from carousel 24 to carousel 81, and one star wheel 86 for removing the capped bottles 2 from the carousel 81.

**[0091]** As shown in Figure 1, carousel 81 is advantageously arranged on the opposite side of flow line R with respect to labelling unit 12.

**[0092]** Operation of apparatus 1 will now be described with reference to one preform 3 and as of the instant in which such preform 3 is fed to blow moulding machine 10 in order to be transformed into a corresponding bottle 2 destined to be subsequently labelled, filled with a pourable product and capped.

**[0093]** In particular, the preform 3, preheated in an oven prior to reaching the input station 21, is fed to the

carousel 20 by star wheel 84 in a vertical position, i.e. having its axis B parallel to axes C, D, E, F, H, I and its neck 8 located on top of the preform 3 itself. More specifically, the preform 3 is received in a respective moulding unit 23 of blow moulding machine 10 to be transformed in a corresponding bottle 2 by injecting a fluid under pressure in the cavity delimited by wall 9 so as to deform such wall to the desired final configuration.

**[0094]** The bottle 2 obtained by the blow moulding operation carried out on the preform 3 is then fed to the adjacent star wheel 82 at output station 22. The bottle 2 is advanced continuously towards the filling machine 11 by the consecutive star wheels 82 in a vertical position, i.e. with its axis A parallel to axes C, D, E, F, H, I and its neck 8 located in an upper position than its bottom wall 5.

**[0095]** The bottle 2 is received by a respective handling unit 28 at input station 25 of carousel 24. In particular, the bottle 2 is retained at its neck 6 by the respective gripping member 53 and supported at the bottom by the respective lower support plate 72. More specifically, the gasket 64 of the relative filling head 63 contacts the neck 6 of the bottle 2, which has a position coaxial with the filling head 63 itself and, more in general, with the handling unit 28. In practice, the axis A of the bottle 2 is coaxial with the axis E of the handling unit 28.

**[0096]** At this point, valve 48 of pressurization circuit 47 is opened (valve 39 of product circuit 38 and valve 76 of decompression circuit 74 are in a closed condition) and is maintained in that condition up to the moment in which pressure in the bottle 2 reaches a given first value H1, for instance about 1,5 bar, adapted to make the bottle 2 sufficiently rigid for labelling. Then, valve 48 is closed.

**[0097]** In the meantime, the handling unit 28 reaches input station 26, where a label 4 is supplied by labelling unit 12 to the bottle 2; in order to allow application of the label 4 on the bottle 2, the latter is rotated about its axis A by activating electric motor 56. In particular, in this stage, rotary motion imparted by output shaft 57 of electric motor 56 to gripping member 53 through gears 58, 59 is transmitted to the bottle 2 and from the latter to the passive rotary portion Z of the handling unit 28, which is in contact with the neck 6 of the bottle 2.

**[0098]** Once the label 4 has been applied on bottle 2, in the case in which the pourable product to be fed into the bottle 2 is a carbonated liquid, a further pressurization step is carried out; even in this case, valve 48 of pressurization circuit 47 is opened and maintained in the open condition up to the moment in which pressure in the bottle 2 reaches a given second value H2, for instance about 6 bar, higher than first value H1 and defining the requested condition for the filling operation with the carbonated liquid. Then, the valve 48 is again closed.

**[0099]** By opening valve 39 of product circuit 38, the actual filling of the bottle 2 with the product can be started (shutter 35 is normally kept by spring 42 in the raised opening position). This step ends when the product reaches the desired level in the bottle 2.

**[0100]** During this step, electric motor 56 is again activated to rotate the bottle 2 about its axis A. Therefore, the bottle 2 is subjected to a revolution motion about axis D and a rotary motion about axis A. Thanks to this double rotation about axes A and D, the bottle 2 can be filled at high speed with a reduced formation of foam. As a matter of fact, the centrifugal force caused by this additional rotation about axis A generates an additional pressure on the product in the bottle 2, which entraps the carbon dioxide into the product. Moreover, the product comes down into the bottle 2 along the lateral wall thereof instead of centrally.

**[0101]** The next step is the decompression of the bottle 2, which is achieved by connecting the bottle 2 with decompression circuit 74.

**[0102]** Also in this step, the bottle 2 is rotated about its axis A, by maintaining electric motor 56 in an activation step. In particular, during the decompression step, the bottle 2 is progressively decelerated and is definitively stopped at the end of this step.

**[0103]** The applicant has observed that, by rotating the bottle 2 during the decompression step, a further reduction of the formation of the foam can be achieved with a consequent relevant reduction of the overall time to complete the filling operation of the bottle 2.

**[0104]** In the case in which the pourable product delivered to the bottle 2 is a non-carbonated liquid, the second pressurization step is not performed.

**[0105]** Once the filling operation has been completed, the bottle 2 is released by carousel 11 to star wheel 85 at output position 27 and then transferred to the carousel 81 of capping machine 13 for performing the capping operation. The bottle 2 finally reaches star wheel 86 to be subsequently transferred to the next processing stations.

**[0106]** The advantages of apparatus 1 according to the present invention will be clear from the foregoing description.

**[0107]** In particular, the apparatus 1 allows to perform the blow moulding, filling, labelling and capping operations by using only three carousel-type machines. In addition, the transfer from one machine to the next is achieved by using consecutive star wheels, without buffers or further processing means so as to move the bottles 2 within the apparatus 1 in a continuous stream and at high speed.

**[0108]** By minimizing the number of machines used to perform the different operations from the preforms 3 to filled, capped and labelled bottles 2, it is possible to achieve a relevant reduction of the footprint of the apparatus 1. Plus, by placing the capping machine 13 on the opposite side of the transfer line from the blow moulding carousel 20 to the filling carousel 24 with respect to the labelling unit 12, the footprint of the apparatus 1 may be further minimized.

**[0109]** Last but not least, by rotating the bottles 2 both during the filling and the decompression steps, it is possible to reduce the formation of foam and therefore to increase the speed at which the bottles 2 are advanced

by the filling carousel 24. In this way, the pitch of the filling carousel 24 may be increased and possibly made equal to that of the blow moulding carousel 20, so further simplifying the structure of the apparatus 1.

**[0110]** Clearly, changes may be made to apparatus 1 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

## Claims

**1.** An apparatus (1) for producing plastic bottles (2) comprising:

- a blow moulding machine (10), which has a blow moulding carousel (20) rotating about a first axis (C) and which is configured to transform a succession of plastic preforms (3) into respective bottles (2);
- a filling machine (11) including a filling carousel (24), rotating about a second axis (D), parallel to the first axis (C), and a plurality of handling units (28) advancing about said second axis (D), receiving the respective bottles (2) fed by the blow moulding carousel (20) and provided with respective filling devices (30) selectively operated to fill the bottles (2), retained by the handling units (28) themselves, with a pourable product;
- labelling means (12) configured to feed a succession of labels (4) to be attached to the respective bottles (2); and
- conveying means (14) configured to transfer the bottles (2) within the apparatus (1);

**characterized in that** said labelling means comprise a labelling unit (12) arranged peripherally to said filling carousel (24) and configured to feed the labels (4) to the handling units (28) carrying the respective bottles (2) while said handling units (28) are advanced by the filling carousel (24); and **in that** said conveying means (14) comprise a plurality of consecutive transport star wheels (82) transferring the bottles (2) in a continuous stream from the blow moulding carousel (20) to the filling carousel (24).

**2.** The apparatus as claimed in claim 1, wherein said conveying means (14) comprise an even number of consecutive transport star wheels (82) connecting the blow moulding carousel (20) to the filling carousel (24).

**3.** The apparatus as claimed in claim 1 or 2, wherein said labelling unit (12) is arranged adjacent to a first sector of the filling carousel (24) immediately downstream of the position (25) at which the bottles (2) are fed to the filling carousel (24) itself by the transport star wheels (82).

**4.** The apparatus as claimed in any one of the foregoing claims, wherein said bottles (2) are advanced from the blow moulding carousel (20) to the filling carousel (24) along a given flow line (R); and wherein said blow moulding machine (10), said filling machine (11) and said labelling unit (12) have control panels (78, 79, 80) located on the same side with respect to said flow line (R).

**5.** The apparatus as claimed in any one of the foregoing claims, wherein the distance of said filling carousel (24) from said blow moulding carousel (20) is only defined by the number of transport star wheels (82) interposed therebetween, without further processing means.

**6.** The apparatus as claimed in any one of the foregoing claims further comprising a capping machine (13) located downstream of said filling machine (11) and connected to said filling machine (11) by at least one transport star wheel (85).

**7.** The apparatus as claimed in claim 6, wherein said capping machine (13) is arranged on the opposite side of said flow line (R) with respect to said labelling unit (12).

**8.** The apparatus as claimed in any one of the foregoing claims, further comprising:

- a pressurization circuit (47) selectively put into communication with each bottle (2) advanced by said filling carousel (24) to feed an operative fluid, pressurized at a pressure higher than the atmospheric pressure, into the bottle (2) itself;
- a decompression circuit (74) selectively put into communication with each bottle (2) advanced by said filling carousel (24) to discharge excess pressure with respect to the atmospheric pressure, after completion of the filling of the bottle (2) itself with the pourable product;
- one actuating device (55) for each handling unit (28) selectively switched to an active state to rotate the relative bottle (2) about its longitudinal axis (A) while the bottle (2) itself is advanced by said filling carousel (24); and
- control means (79) configured to control activation/deactivation of each filling device (30) and each actuating device (55) as well as connection of said pressurization circuit (47) and said decompression circuit (62) with each bottle (2);

wherein said control means (79) are configured to simultaneously maintain each actuating device (55) in an active state while said decompression circuit (62) is in communication with the relative bottle (2) so as to rotate the bottle (2) itself about its longitudinal axis (A) during de-

compression thereof.

**9.** The apparatus as claimed in claim 8 when depending on any one of claims 4 to 7, wherein said control means comprise said control panel (79) of said filling machine (11).

**10.** The apparatus as claimed in claim 8 or 9, wherein said control means (79) are also configured to maintain each actuating device (55) in the active state while the corresponding filling device (30) is activated so as to rotate the relative bottle (2) about its longitudinal axis (A) during filling thereof with the pourable product.

**11.** The apparatus as claimed in any one of claims 8 to 10, wherein each actuating device (55) is controlled by said control means (79) to decelerate the relative bottle (2) during decompression.

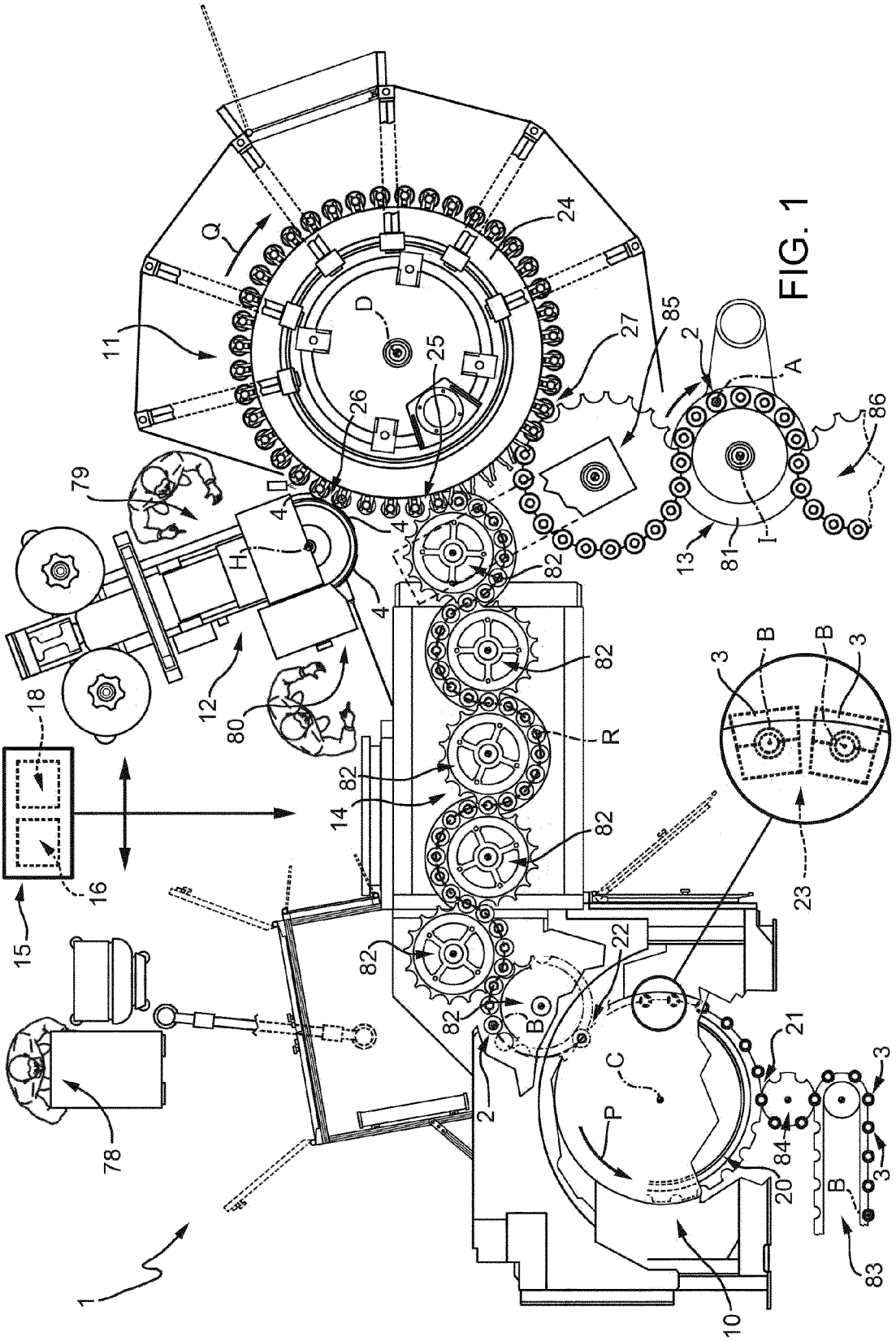

Q
D
11
24
25
26
27
85
2
A
86
79
4
H1
12
80
13
81
I
82
R
14
18
16
15
78
1
22
B
C
P
21
20
84
3
83
10
23

FIG. 1

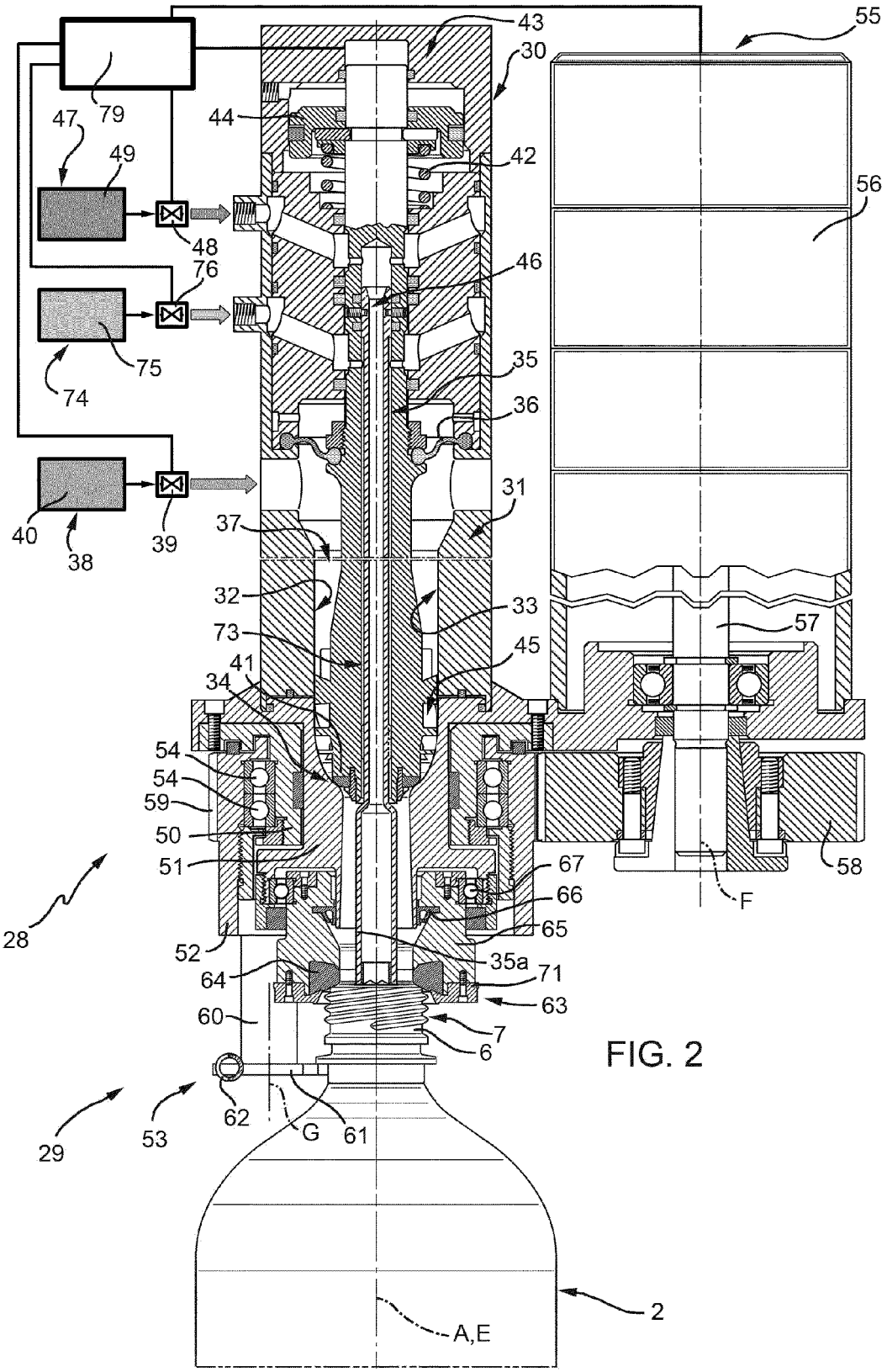
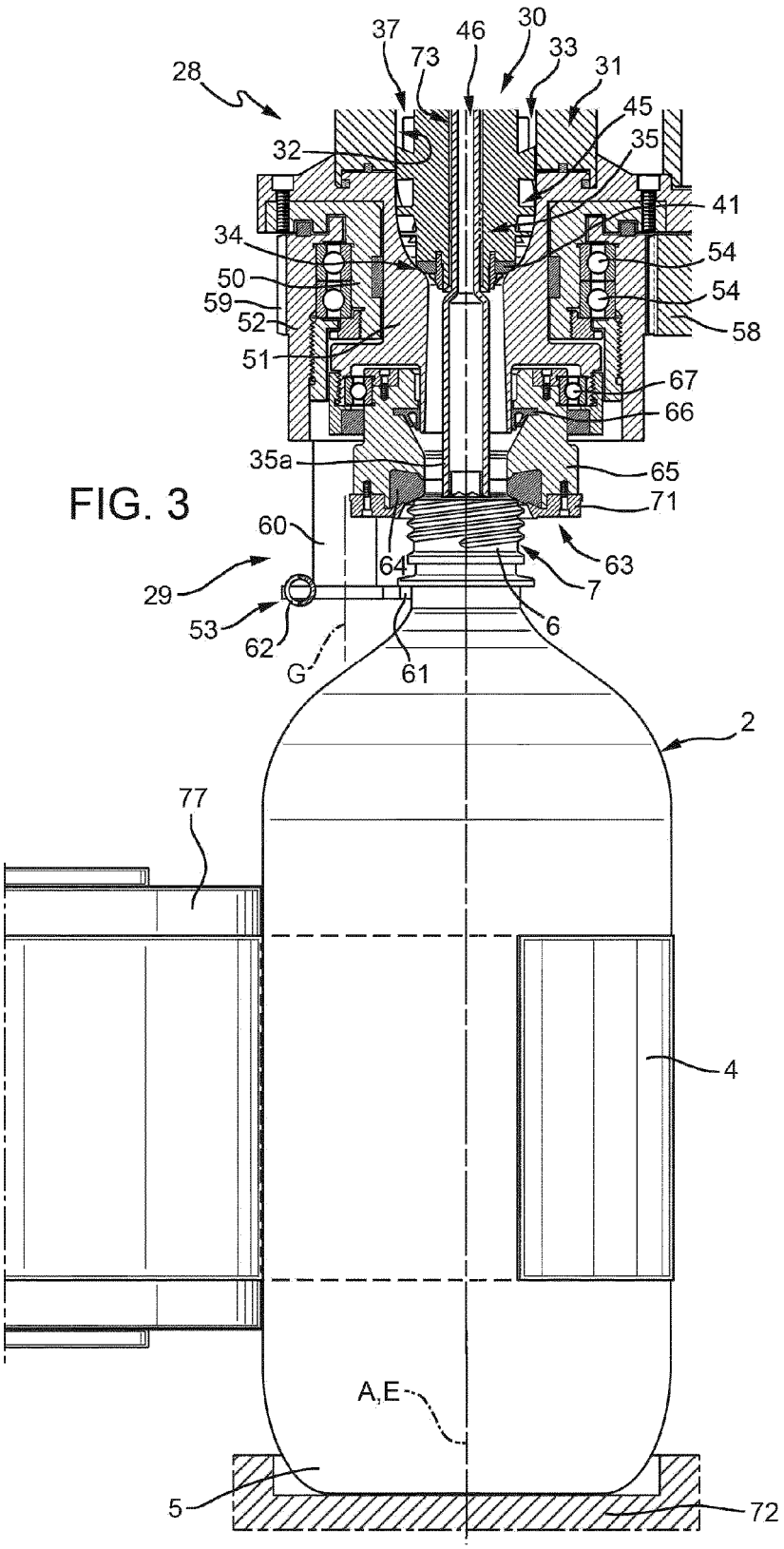

43
55
30
79
47
44
49
42
56
48
46
76
75
74
35
36
31
40
38
39
37
32
33
73
57
45
41
34
54
54
59
50
51
67
66
65
58
F
28
52
64
35a
71
63
60
7
6
62
G
61
29
53
2
A,E

FIG. 2

FIG. 3


37
46
30
73
33
31
28
45
35
32
41
34
54
50
54
59
58
52
51
67
66
35a
65
71
60
63
64
7
29
6
53
62
61
G
2
77
4
A,E
5
72

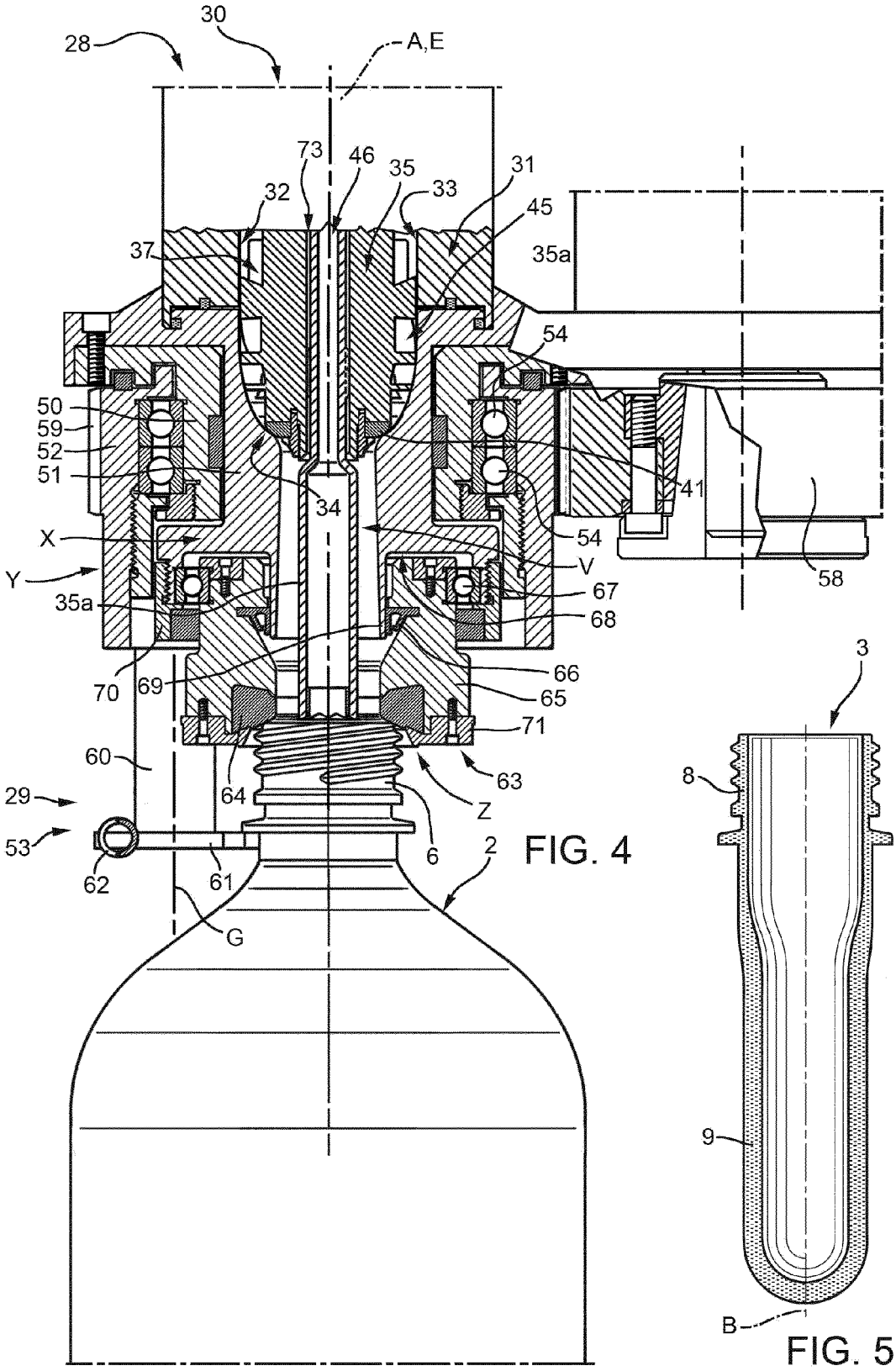

28
30
A,E
73
46
35
31
32
33
45
37
35a
54
50
59
52
51
41
34
54
X
V
Y
67
35a
68
70
69
66
65
71
60
63
64
Z
29
53
6
2
62
61
G
58

FIG. 4


3
8
9
B

FIG. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 15 30 6464

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| Y | WO 2014/102075 A1 (SIDEL SPA CON SOCIO UNICO [IT]) 3 July 2014 (2014-07-03)<br>* figures 1-3 *<br>* page 3, line 26 - page 13, line 16 * | 1-11 | INV.<br>B65C3/16<br>B65C9/04<br>B67C3/00<br>B67C3/26 |
| Y,D | US 2011/056172 A1 (KLENK CHRISTOPH [DE] ET AL) 10 March 2011 (2011-03-10)<br>* figures 1-3 *<br>* paragraphs [0016], [0017], [0022] - [0037] *<br>* claim 13 * | 1-11 | B67C7/00 |
| Y | DE 10 2010 009137 A1 (KRONES AG [DE]) 25 August 2011 (2011-08-25) | 4 | |
| A | * figures 1-2 *<br>* paragraphs [0033], [0034], [0041] - [0051] * | 2 | |
| A | EP 2 295 324 A1 (KRONES AG [DE]) 16 March 2011 (2011-03-16)<br>* figures 1-3 * | 2 | |
| A | EP 2 889 229 A1 (SIDEL SPA CON SOCIO UNICO [IT]) 1 July 2015 (2015-07-01)<br>* figures 1-11 *<br>* paragraphs [0068] - [0100] * | 1 | TECHNICAL FIELDS SEARCHED (IPC)<br>B67C<br>B65C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 26 February 2016 | Pardo Torre, Ignacio |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 30 6464

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-02-2016

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 2014102075 A1 | 03-07-2014 | CN 104884352 A | 02-09-2015 |
| | | EP 2749501 A1 | 02-07-2014 |
| | | EP 2938545 A1 | 04-11-2015 |
| | | JP 2016501795 A | 21-01-2016 |
| | | WO 2014102075 A1 | 03-07-2014 |
| US 2011056172 A1 | 10-03-2011 | CN 102009931 A | 13-04-2011 |
| | | DE 102009040363 A1 | 10-03-2011 |
| | | EP 2292550 A1 | 09-03-2011 |
| | | US 2011056172 A1 | 10-03-2011 |
| DE 102010009137 A1 | 25-08-2011 | CN 102781813 A | 14-11-2012 |
| | | DE 102010009137 A1 | 25-08-2011 |
| | | EP 2539272 A1 | 02-01-2013 |
| | | US 2012311962 A1 | 13-12-2012 |
| | | WO 2011104137 A1 | 01-09-2011 |
| EP 2295324 A1 | 16-03-2011 | CN 102019686 A | 20-04-2011 |
| | | DE 102009041215 A1 | 24-03-2011 |
| | | EP 2295324 A1 | 16-03-2011 |
| | | JP 5664955 B2 | 04-02-2015 |
| | | JP 2011056943 A | 24-03-2011 |
| | | US 2011061343 A1 | 17-03-2011 |
| EP 2889229 A1 | 01-07-2015 | CN 104743178 A | 01-07-2015 |
| | | EP 2889229 A1 | 01-07-2015 |
| | | JP 2015129019 A | 16-07-2015 |
| | | US 2015183533 A1 | 02-07-2015 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- US 20110056172 A **[0008] [0009]**